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AUTHOR Thomas, Edward L., Comp.
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IDENTIFIERS *Vocational Education Readiness Test

ABSTRACT

Focusing on welding, this module is one of eight included in the Vocational Education Readiness Tests (VERT). The module begins by listing the objectives of the module and describing tools and equipment needed. The remainder of the module contains sections on manipulative skills, trade vocabulary, tool identification, trade computational skills, and measuring skills depicted as minimum competencies students should possess prior to entrance into regular secondary vocational education programs. (A user's guide is also available--see note.) (LRA)

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Module 8 of the Vocational Education Readiness Test (VERT)

WELDING

Compiled by:
Edward L. Thomas

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WELDING

Objective(s):

1. To determine the student's ability to measure in inches, half-inches, quarter-inches, and eighth-inches.
2. To determine the student's ability to utilize a welding whip and rod in a flat position.
3. To determine the student's ability to utilize a welding whip and rod in a vertical corner.
4. To determine the student's ability to utilize a welding whip and rod in an overhead standing position.
5. To determine the student's ability to utilize a welding whip and rod in a vertical facing position.
6. To determine the student's ability to utilize a welding whip and rod on cylindrical surface in a kneeling position.

Tools Needed:

1 - Welding Shield with clear glass

1 - Welding whip 6' to 8' with electrode holder (no. 2-0 cable)

1 - Black lead pencil No. 2

1 - 6" PVC pipe 12" long

Welding Booth

3 - 2"-3" pipe clamps

1 - Steel pipe size 2" × 7'

2 - Clip Board clamps

3 - Sheets plywood ¾"

Note: See Appendices A and B for welding booth specifications.

Preliminary Exercise:

The evaluator will identify a 12" plastic rule and demonstrate how to measure to the nearest inch, half-inch, quarter-inch, and eighth-inch. Answer any questions at this time; however, avoid *"teaching"* the student to measure by giving repeated demonstrations. (See Figure 1.)

Special Instructions: Lines for Tasks 1 - 4 should measure 3", 3 1/2", 3 1/4", and 3 1/8", respectively, and should be drawn on a separate sheet of paper.

Figure 1.

Task 1: _____*

Task 2: _____*

Task 3: _____*

Task 4: _____*

Tasks 1 through 4

Given a 12" plastic rule and measuring tasks 1, 2, 3, and 4, the student will measure the line in each task and tell his/her findings to the evaluator.

*Lines are drawn on separate sheet to respective length by evaluator.

Preliminary Exercise:

The evaluator will demonstrate how to use a welding whip and marking pencil to simulate welding in a flat position.

Special Instructions: Have student wear welding helmet!

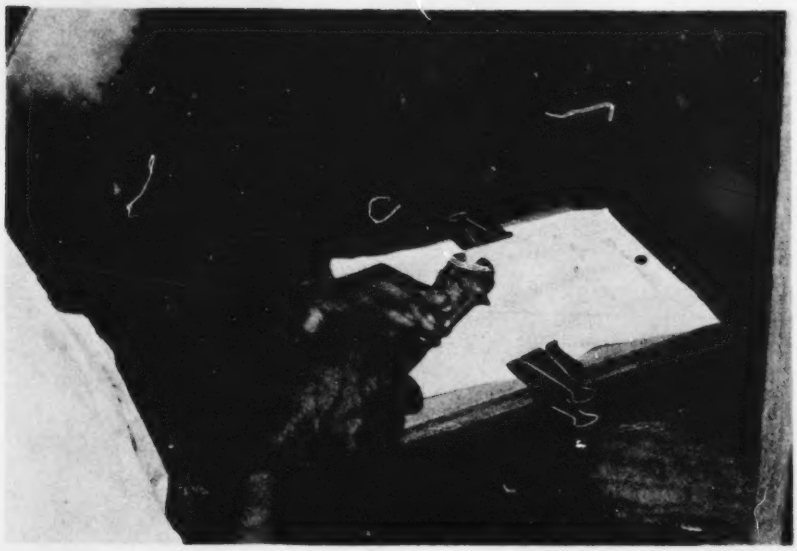


Figure 2.

Task 5

Given a welding helmet, welding whip, and marking pencil, the student will mark a welding pattern which is in a flat position. Note Errors! **Note Time!**

Preliminary Exercise:

The evaluator will demonstrate how to utilize a welding whip and marking pencil to simulate welding in a corner position.

Special Instructions: Have student wear welding helmet!

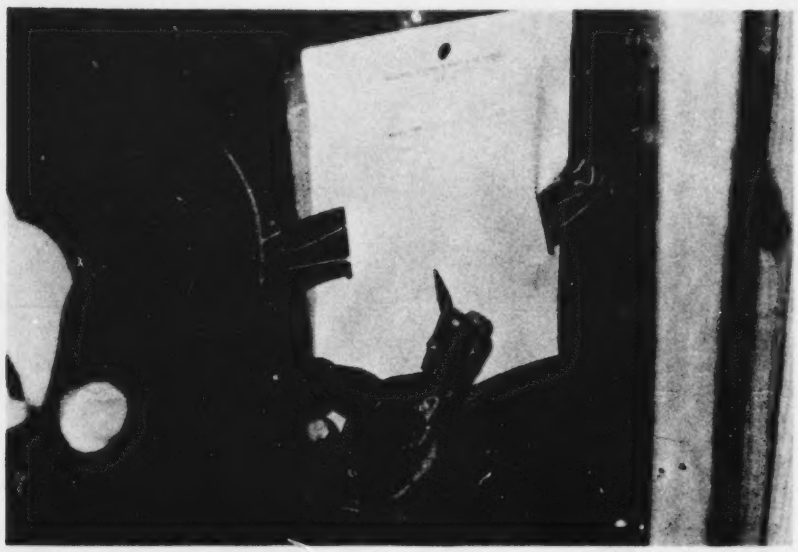


Figure 3.

Task 6

Given a welding helmet, welding whip, and marking pencil the student will mark a welding pattern mounted in the corner of the welding mock-up. Note Errors! **Note Time!**

Preliminary Exercise:

The evaluator will demonstrate how to use a welding whip and marking pencil to simulate welding in an overhead standing position.

Special Instructions: Have student wear welding helmet!

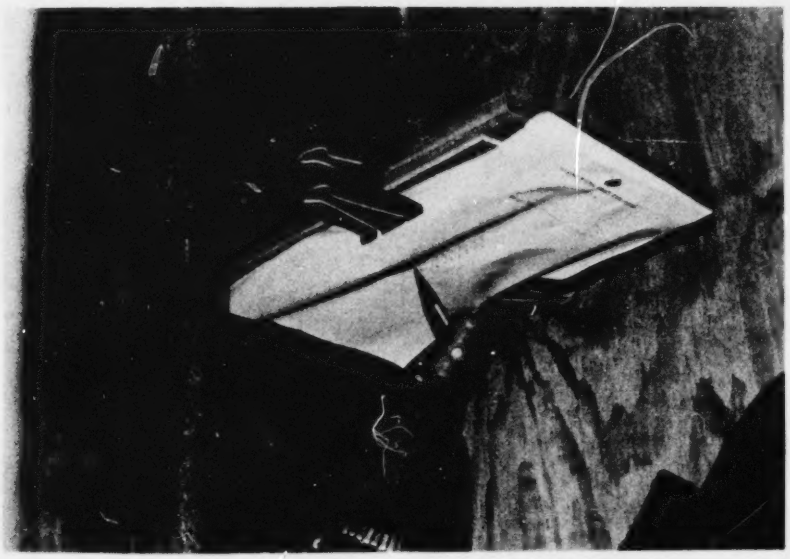


Figure 4.

Task 7

Given a welding helmet, welding whip, and marking pencil, the student will mark a welding pattern in an overhead standing position. Note Errors! **Note Time!**

Preliminary Exercise:

The evaluator will demonstrate how to use a welding whip and marking pencil to simulate welding in a vertical facing position.

Special Instructions: Have student wear welding helmet!

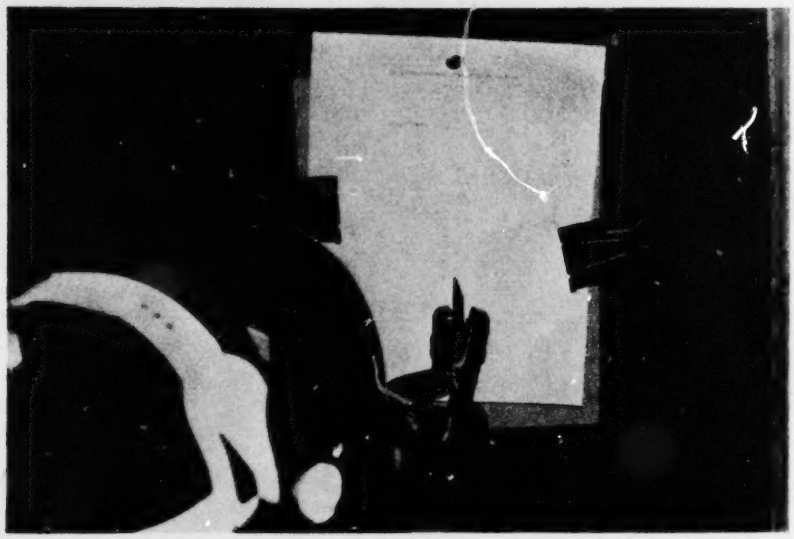


Figure 5.

Task 8

Given a welding helmet, welding whip, and marking pencil the student will mark a welding pattern which is mounted on a vertical structure and is facing toward the student. Note Errors! **Note Time!**

Preliminary Exercise:

The evaluator will demonstrate how to use a welding whip and marking pencil to simulate welding on a cylindrical surface in a kneeling position.

Special Instructions: Have student wear welding helmet!

Figure 6.

Task 9

Given a welding helmet, welding whip, and marking pencil, the student will mark a welding pattern on a cylindrical surface while in a kneeling position Note Errors! **Note Time!**

VOCATIONAL EDUCATION READINESS TEST (VERT)
SCORING RESULTS SHEET FOR WELDING

(Example Only)

Name _____

Student Performance Data

	Time*				
	Acceptable**	Unacceptable**			
Task 1	____	_____	(1/2")	X	Measure-ment Skills
Task 2	_____	_____	(1/4")	X	
Task 3	_____	_____	(1/8")	X	
Task 4	_____	_____	(1/16")	X	
Task 5	_____	_____	Est. Local Criteria		
Task 6	_____	_____	Est. Local Criteria		
Task 7	_____	_____	Est. Local Criteria		
Task 8	_____	_____	Est. Local Criteria		
Task 9	_____	_____	Est. Local Criteria		

*The local school system should establish criteria for acceptable or unacceptable performance on the above tasks, i.e. 80% completion, etc. for acceptable performance.

Welding Vocabulary

AC (Alternating Current): The kind of electricity which reverses the direction of electron flow regularly and periodically. The period of alternating depends upon the cycle of current. For 60-cycle current, the current goes in one direction and then in the other direction 60 times in one second. Therefore, the current changes its direction 120 times in one second.

ACETYLENE: Gas composed of two parts carbon and two parts hydrogen. When burned in the atmosphere, it produces one of the highest temperatures.

ALLOY: A material made up of two or more elements. One of the elements must be a metal.

ANNEALING: Softening metal by using heat.

ANODE: Electrical term for positive. The part of an electrical circuit to which the electrons are flowing.

ARC: The flow of electricity thorugh a gaseous space or air gap.

ARC BLOW: Magnetic disturbance of the arc which causes it to waver (change) from its path.

ARC LENGTH: The distance from the end of the electrode to the point where the arc makes contact with the work surface.

ARC VOLTAGE: The voltage (potential) across the arc.

ARC WELDING: The name given to several types of welding processes in which coalescene (bonding) is produced by heating with electric arcs. Pressure may or may not be used.

AS WELDED: The condition of weld metal, welded joints and weldments after welding and before any other treatment.

BACKFIRE: A short "pop" of the torch flame just before the flame goes out.

BACKING: Material used to back up a joint during welding so that the weld will be more sound.

BACK-STEP WELDING: Welding small sections of a joint in a direction opposite to the direction the weld as a whole is being made.

BARE ELECTRODE: A filler metal electrode used in arc welding. It consists of a metal wire with no coating.

BASE METAL: The metal to be welded or cut.

BEAD: The appearance of the weld. Small ripples formed by the weld while it was in a semi-liquid state.

BOND: Junction of the weld metal and the base metal.

BRAZE WELDING: Making an adhesion groove, fillet, or plug connection with a brazing alloy (copper and tin).

BRITTLENESS: The tendency of material which is not deformed to fail suddenly by breaking.

BUTT JOINT: The type of joint in which the edge of one piece touches the edge of another piece.

BUTT WELD: A weld in a butt joint.

CATHODE: Electrical term for the negative terminal of an electrical circuit.

CHAMFER: The contour made on the edge of a piece which is to be welded.

CIRCUIT: A closed electrical loop returning to the starting point.

COMPRESSIVE STRENGTH: The amount of resistance a material has to a force which is trying to crush it.

CONCAVE WELD FACE: A weld having the center of its face below the weld edges.

CONDUCTOR: A material or substance which allows an electric current to flow through it.

CONTINOUS WELD: Making the complete weld in one operation.

CONVEX WELD: A weld with the face above the weld edges.

CORNER JOINT: Junction of two pieces of metal at a ninety degree (right) angle.

COVERED ELECTRODE: A filler-metal electrode used in arc welding, consisting of a metal core wire with a thick covering. The covering protects the molten (melted) metal from the atmosphere and therefore makes a better weld and more stable arc.

CYCLE: One complete reversal of an alternating current from positive to negative and back to the starting point.

CRATER: A depression at the end of a weld.

DC (Direct Current): Electrons in an electrical circuit moving in the same direction at all times.

DIRECT POLARITY: Direct current flowing from the cathode (the electrode which is negative) to anode (base metal which is positive). Also known as direct current straight polarity.

DISTORTION: Warping of a structure.

DOWNHAND WELDING (Flat Position Welding): A horizontal weld on the upper surface of a horizontal surface.

DUCTILITY: Capable of being drawn out or hammered thin.

ELECTRODE: The material which brings electricity up to the point where the arc is to be formed. In electric arc welding, the electrode is usually melted and becomes a part of the weld.

ELECTRON: A negatively charged particle.

FACE OF WELD: The exposed surface of the weld.

FILLER ROD: Metal wire that is melted and added to the welding puddle to produce the necessary bead thickness. Also called welding rod.

FILLET: Weld metal in the corner or angle formed by two pieces of metal, giving the joint strength to withstand unusual stress.

FILLET WELD: Metal fused into an inside corner.

FLUX: A fusible material or gas used to dissolve and/or prevent the formation of oxides, nitrides, or other unwanted elements formed by welding.

FUSION: The mixing and blending of metals which have been melted to a liquid state.

GAS METAL ARC WELDING (MIG): Welding using a continuously fed consumable electrode and a shielding gas.

GAS POCKETS: Cavities in weld metal caused by entrapped gas.

GAS TUNGSTEN ARC WELDING (TIG): Welding using a tungsten electrode, (nonconsumable), and a shielding gas. A filler rod is added to the arc.

GROOVE WELD: A welding rod fused to a joint which has had the base metal removed to form a **V, U,** or **J** at the edge of the metals to be joined.

HEAT AFFECTED ZONE: The part of the base metal which has been altered by heat but not melted.

HIGH CARBON STEEL: Steel containing at least 45% carbon.

HORIZONTAL POSITION: A weld performed on a horizontal seam on a vertical surface.

JOINT: Point where two pieces of a structure meet.

LAP JOINT: A joint between two overlapping pieces.

LEG OF FILLET WELD: The distance from the point where two base metals meet (root) to the toe of the fillet.

LOW CARBON STEEL: Steel containing no more than 20% carbon.

MELTING RATE: The amount (by weight or length) of electrode that melts in a given unit of time.

METAL: An element that has most or all of these qualities: (1) solid at room temperature, (2) opaque (not transparent), (3) conductor of heat and electricity, (4) reflective when polished, (5) expands when heated and contracts when cooled.

MULTIPLE PASS WELD: A weld in which there are several layers of weld bead.

NEUTRAL FLAME: Flame which results from combustion of perfect proportions of oxygen and fuel gas.

NOZZLE: Part of the torch at the end where the gas burns, producing the high temperature flame.

OPEN CIRCUIT VOLTAGE: The voltage produced by the welder when the machine is running and no welding is being done. After the arc is struck, the voltage drops to arc (or working) voltage.

OVERHEAD POSITION: A weld made on the underside of the joint with the face of the weld in a horizontal plane.

OVERLAP: The weld metal protrudes (sticks out) beyond the bond at the toe of the weld.

OXYACETYLENE: The flame produced by the combustion of a mixture of oxygen and acetylene. The amounts of oxygen and acetylene combined can vary.

PASS: Weld metal created by one progression (pass) along the weld.

PEENING: Working metal with hammer blows. The blows may be made by hand or by power tools.

PENETRATION: The distance the fusion extends (goes) below the surface of the metals being welded.

PLUG WELD: Weld which holds two pieces of metal together. The weld is made in a hole in one piece of metal which is lapped over the other piece.

POLARITY: Direction of current flow, (toward negative pole or toward positive pole), in an electric circuit.

POROSITY: Gas pockets or voids (vacant spaces) in metal.

POSITION OF WELDING: Flat, horizontal, overhead, or vertical.

POST HEATING: Heat applied to work after welding or cutting.

PREHEATING: The heat applied to work before welding or cutting.

PUDDLE: Portion of the weld that is molten (in a liquid state) where heat is applied.

RADIOGRAPHY: Passing x-rays or gamma rays through an object to study the metal without destroying it.

REINFORCEMENT OF WELD: Excess metal on the face of a weld.

RESISTANCE: The characteristic of a body (metal, for example) which resists or limits the flow of electricity through it.

REVERSED POLARITY: (Electrode Positive). Electron flow from the base metal to the electrode. Refers to direct current.

RHEOSTAT: A resistor for regulating current.

ROOT PASS: The first bead of a beveled joint.

ROOT OF WELD: The points where the bottom of the weld intersects the base metal surfaces.

ROOT OPENING: The separation at the base of the joint between two parts which are to be welded.

SHIELDED METAL: (Arc Welding) A form of electric welding in which a heavy flux-coated electrode is used.

SIZE OF WELD: Groove or fillet.

SLAG INCLUSION: Non-metallic, (not metal), solid material entrapped in weld metal or between weld metal and base metal.

SOLDERING: Method of fastening two metals together by causing a third metal to adhere to them. Only the joining metal is melted, (at temperatures below 800° F), during the operation.

SPATTER: In arc and gas welding, the metal particles thrown off during welding. These particles do not form a part of the weld.

STRAIGHT POLARITY: (Electrode Negative) Electron flow from the electrode to the base metal. Refers to direct current.

STRING BEAD: A type of weld made with almost no transverse oscillation (waves).

STRINGER BEAD: Same as root pass. The initial (first) bead.

TACK WELD: A weld, usually short, made to hold parts of a weldment in the proper place until the final weld is made.

TEE-JOINT: Joint formed by placing one metal against another at a 90° angle.

TENSILE STRENGTH: The resistance of a material to a force which is trying to pull it apart.

THROAT OF A FILLET (Actual Throat): Distance from the weld root to the weld face.

TIP: Part of the torch at the end where the gas burns.

TOE OF WELD: Junction of the face of the weld and the base metal.

ULTIMATE TENSILE STRENGTH: The maximum stress a material can stand before it is broken apart. Usually expressed in pounds per square inch.

UNDERBEAD CRACK: A crack in the heat-affected surface which does not reach the surface of the base metal.

UNDERCUT: A groove melted into the base metal next to the toe of the weld. It is left unfilled by weld metal.

UPHILL WELDING: A pipe welding term which means that the welds are made from the bottom of the pipe to the top of the pipe. The pipe itself is not rotated.

VERTICAL POSITION: The position in which the axis of weld is almost vertical.

WEAVING: A method of depositing weld metal in which the electrode is oscillated (moved back and forth).

WELDING: A process in which metals are joined by heating them to their melting point and allowing the molten portions to flow together and freeze.

WELD METAL: Fused portion of base metal or of base metal and filler metal.

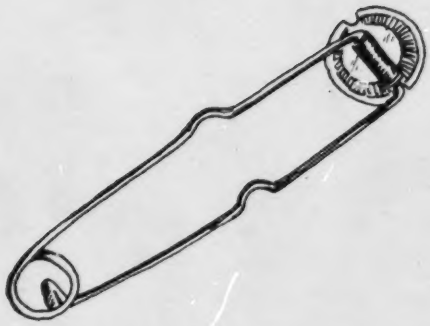
WELDING ROD: Wire which is melted into the weld area as filler.

WELDING SEQUENCE: Order in which the components (parts) of a structure are welded.

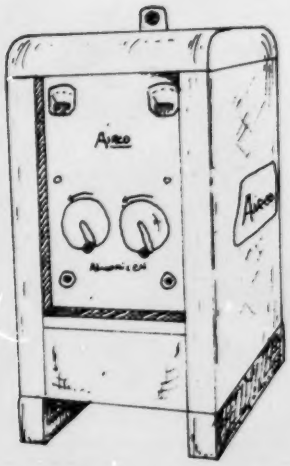
WELDMENT: Assembly of components joined by welding.

WHIPPING: Moving the electorde inward and upward in vertical welding to avoid undercut.

Tools for Welding



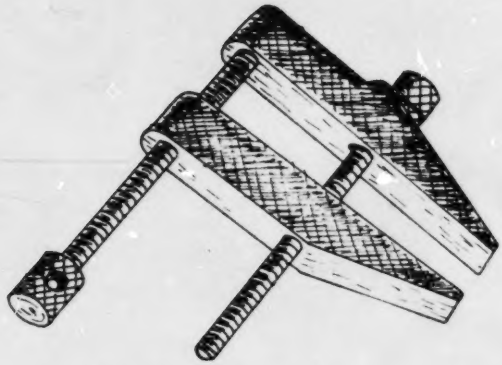
STRIKER



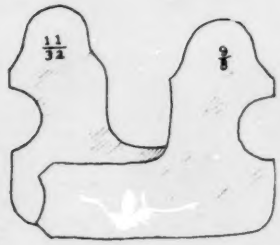
ARC WELDING MACHINE

GROUND CLAMP

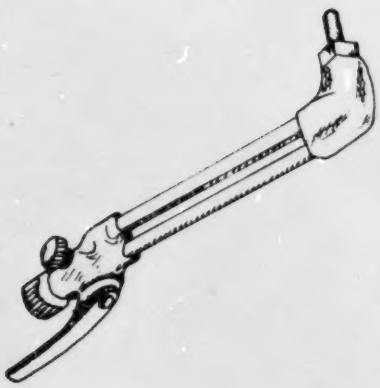
ELECTRODE HOLDER



PARALLEL CLAMP



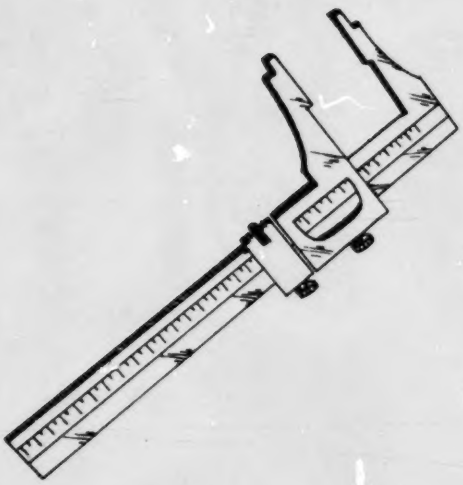
RADIUS GAUGE



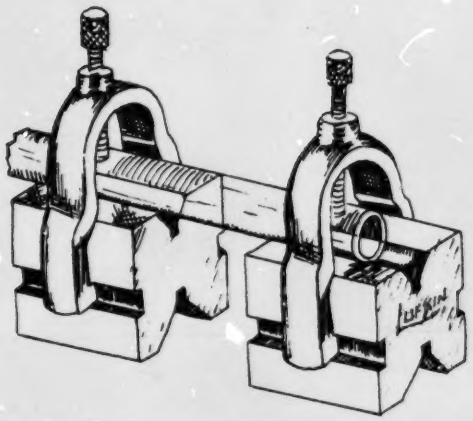
CUTTING
TORCH AND TIP

FIRE EXTINGUISHER

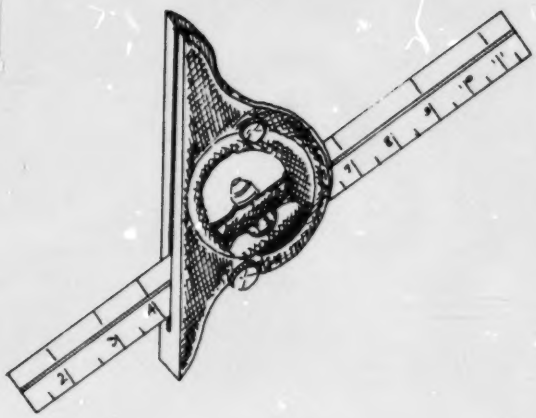
20



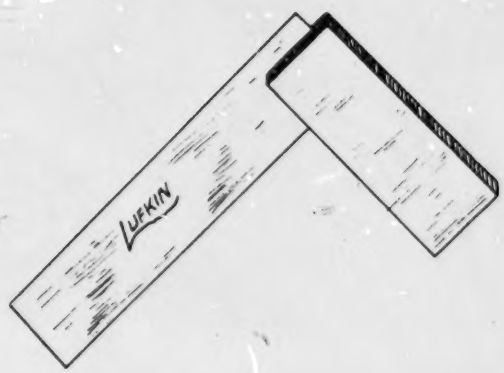
VERNIER CALIPER



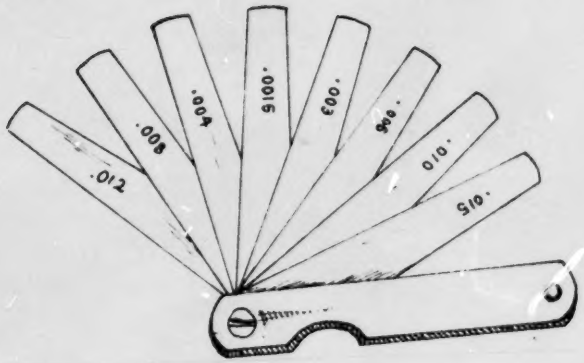
VEE BLOCKS
AND CLAMPS



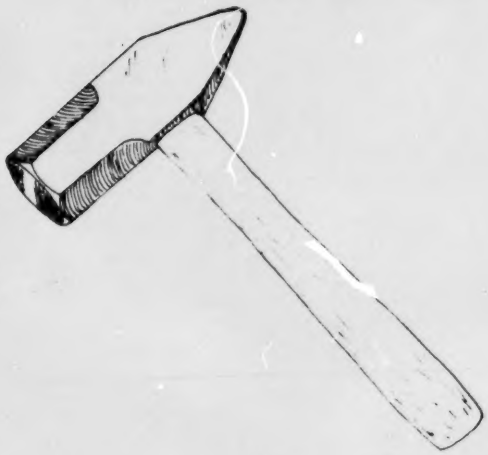
COMBINATION SQUARE



TRY SQUARE



THICKNESS GAUGE

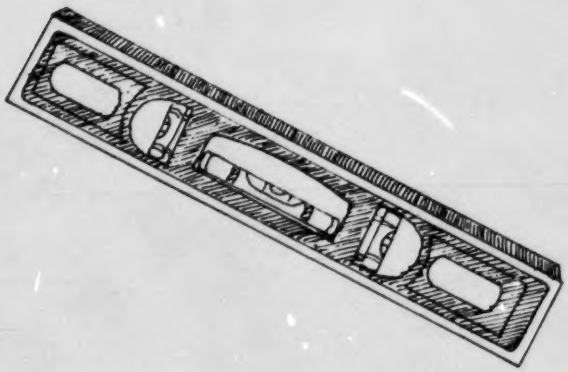


CROSS PEEN HAMMER

C-CLAMP

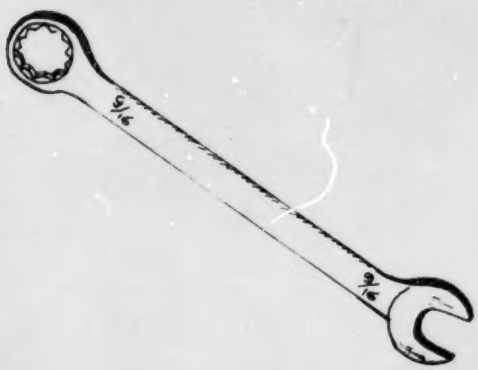
ROUND MILL FILE

22



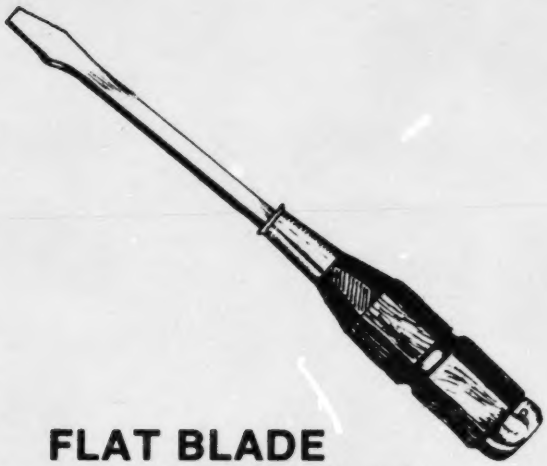
MACHINIST LEVEL

DEPTH GAUGE

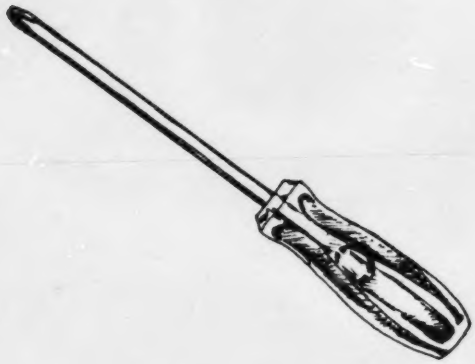


BOX AND
OPEN END WRENCH

STRAIGHT EDGE



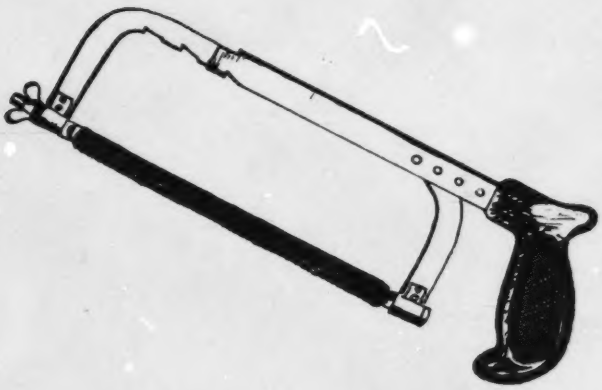
FLAT BLADE
SCREWDRIVER



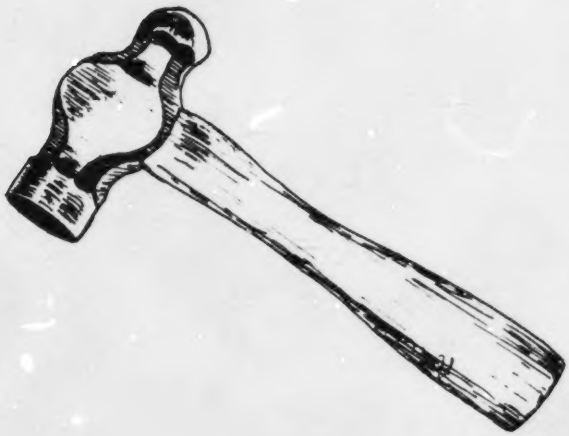
PHLLIPS
SCREWDRIVER

PRY BAR

FLAT MILL FILE



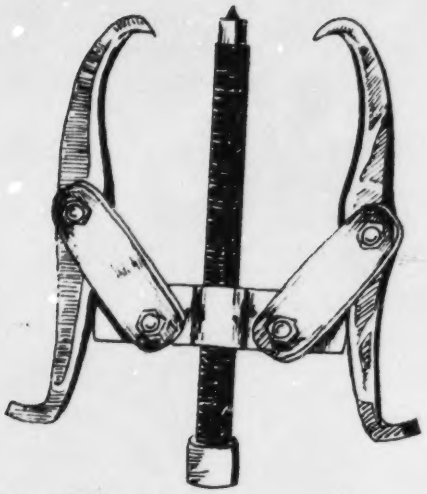
HACKSAW FRAME
AND BLADE



BALL PEEN HAMMER

SAFETY GOGGLES

ADJUSTABLE WRENCH



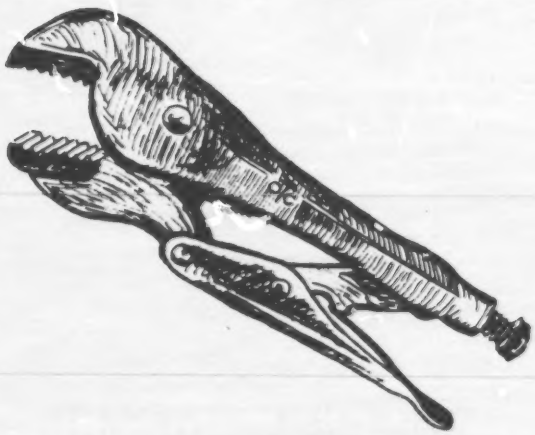
GEAR AND
BUSHING PULLER

PIN PUNCH

FLAT COLD CHISEL

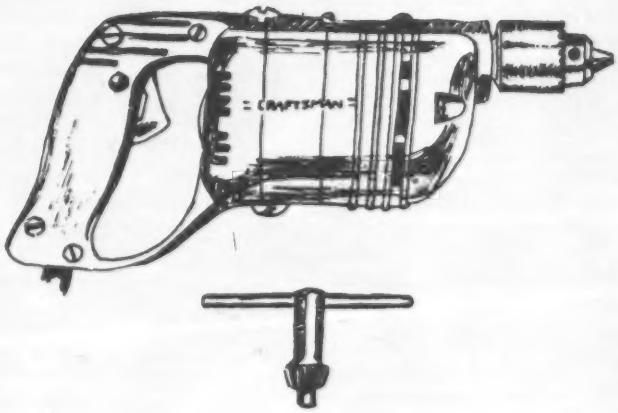
TONGS

HAND VISE

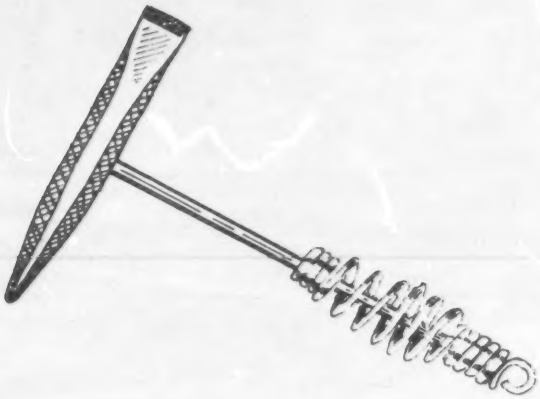


VISE GRIP WRENCH

CENTER PUNCH

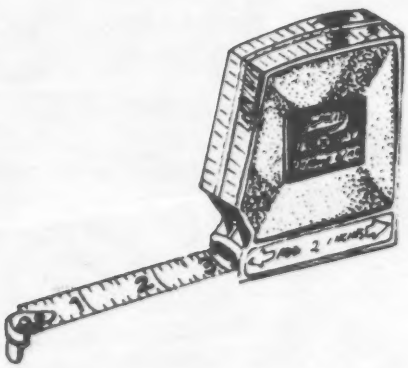


PORTABLE
ELECTRIC DRILL



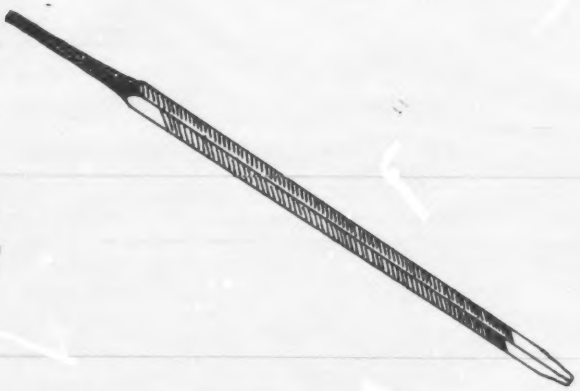
CHIPPING HAMMER

WELDING FLUX



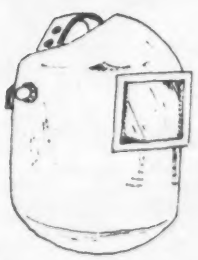
PUSH/PULL RULE

SLIP JOINT PLIERS



6 INCH STEEL RULE

SQUARE FILE



WELDING HELMET

POWER LEAD

COMPUTATIONAL SKILLS
FOR
Welding

Addition:

1 1/3	2 3/4	4 7/8	5 1/2	3 1/2	19 7/16	46 1/8
+2 2/3	3 1/2	6 7/8	6 1/4	9 1/2	17 3/16	55 3/8

125	2,320	12.88	1.67	.06	.92	56
56	199	11.22	.09	.07	.09	43
						7
						19

132		
88	1/2	11 5/16
11	3/4	6 1/4
121	1/3	3 3/8

Subtraction:

18	10.3	11 1/2	8 3/8	22 3/4	13 11/16
-7	6.8	3 1/4	4 5/8	6 1/2	2 3/16

1/67	.92	23.04	16.50	112.62	110.17
.09	.09	3.97	8.51	99.73	109.79

Multiplication:

15 × 3=	2.3 ×6.8 =	1/4 × 1/2 =
22 × 22=	9.9 × 13.4 =	8 × 9.5 =
11 × 110 =	11.5 × 16 =	12 × 11 =

Division:

4 ÷ 2 =	129.6 ÷ 10 =	25.5 ÷ 5 =
16 ÷ 2 =	44 ÷ 12 =	25.5 ÷ 15 =
36 ÷ 6 =	116 ÷ 36 =	1080 ÷ 33 =

Reading Problems

1. Arrange the following fractions from the smallest to the largest.

   3/8, 1/2, 3/16, 1/8, 5/32, 5/8,

   _____ _____ _____ _____ _____ _____

2. Change the following fractions to decimals, i.e. 1/2 = .50.

   2/5 = _____ 1/3 = _____ 7/10 = _____ 9/16 = _____
   3/16 = _____ 1/4 = _____ 3/8 = _____ 4/5 = _____
   5/8 = _____ 13/16 = _____

3. Change the following decimals to fractions, i.e. .25 = 1/4.

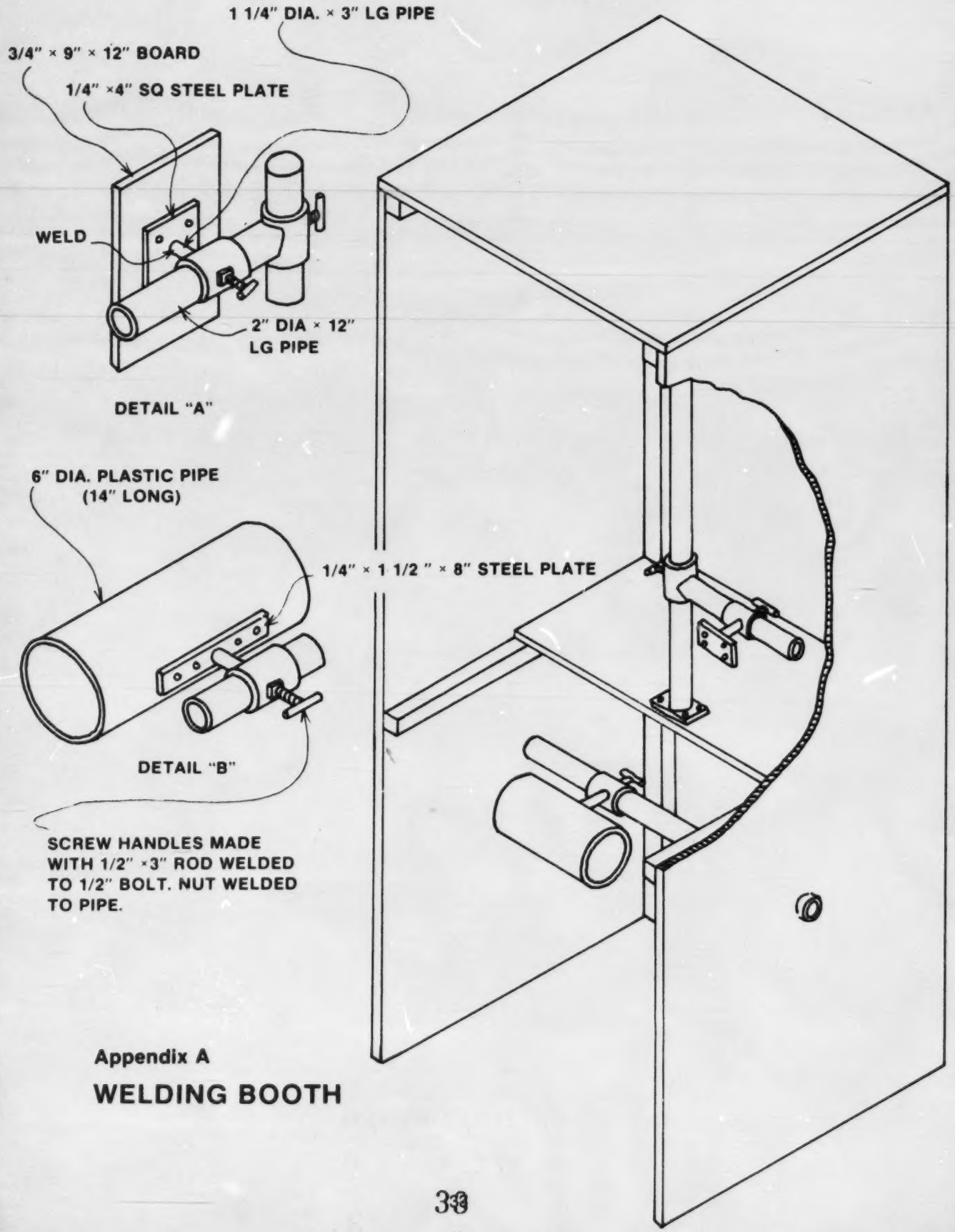
   .50 = _____ .75 = _____ .90 = _____ .10 = _____
   .33 = _____ .80 = _____ .60 = _____ .20 = _____

4. You have accepted a job as a beginning line welder for $6.50 per hour for a 40 hour work week. How much money will you earn per week? Per year?

5. You can weld for ACME Fabrications for $325. per 50 hour work week or for AMCO Welding for $6.50 per hour for the first 40 hours and time and a half for the next 10 hours (total = 50 hours.) With which company would you make the most money?

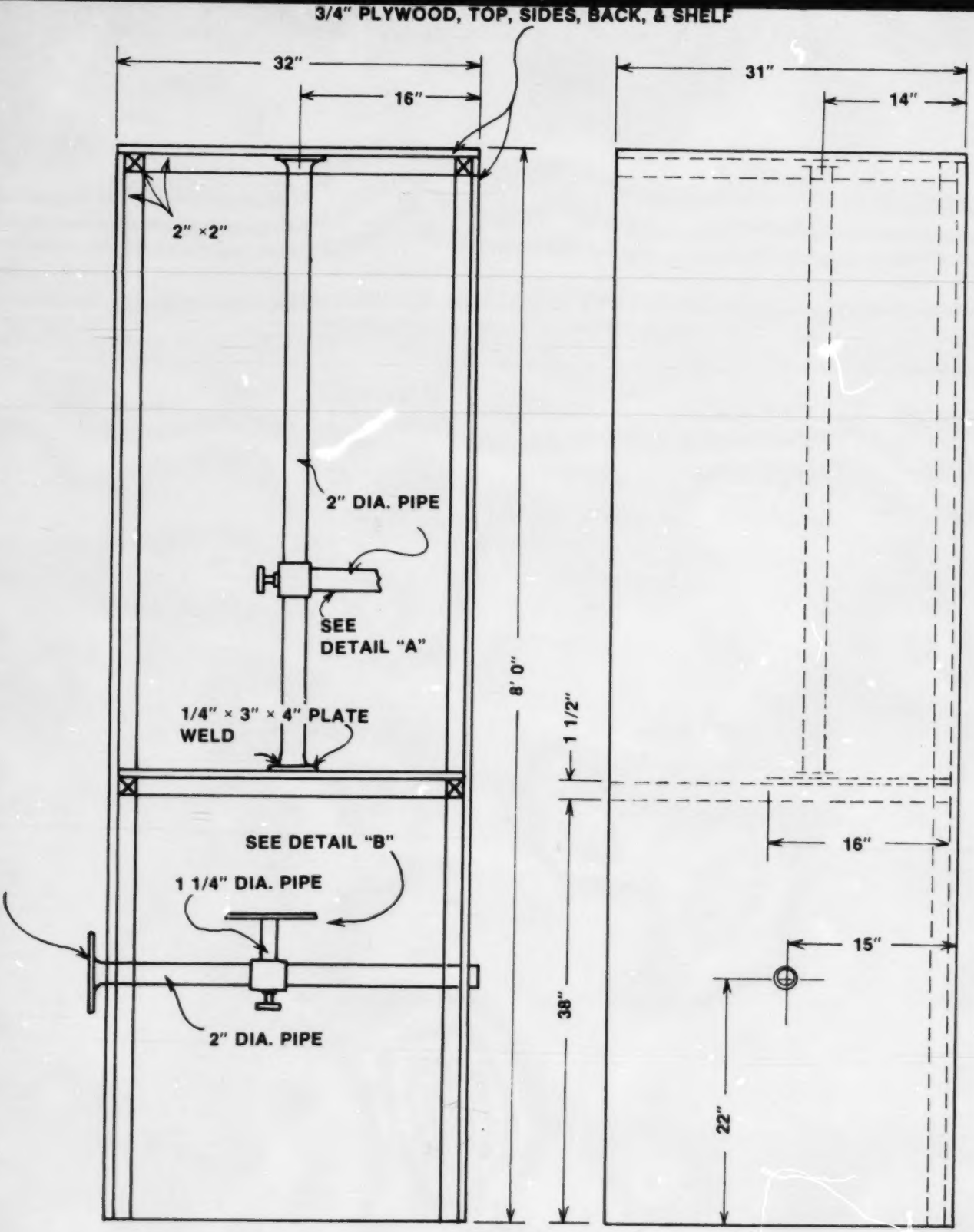
6. You purchased welding gloves for $10.00, helmet for $15.00, cutting goggles for $10.00 and safety shoes for $38.00. You had $86.00 in cash for the above items. Did you have enough money?

7. Your welding shop uses 20 pounds of 3/8 inch welding rods per week at a cost of 50 cents per pound. You are instructed to order a month's supply of the rods. How many pounds of rods would you order and how much would they cost you?


1 1/4" DIA. × 3" LG PIPE
3/4" × 9" × 12" BOARD
1/4" ×4" SQ STEEL PLATE
WELD
2" DIA × 12" LG PIPE
DETAIL "A"
6" DIA. PLASTIC PIPE (14" LONG)
1/4" × 1 1/2 " × 8" STEEL PLATE
DETAIL "B"
SCREW HANDLES MADE WITH 1/2" ×3" ROD WELDED TO 1/2" BOLT. NUT WELDED TO PIPE.

Appendix A

WELDING BOOTH



Appendix B

WELDING BOOTH

SCALE: 1" = 1' 0"

34